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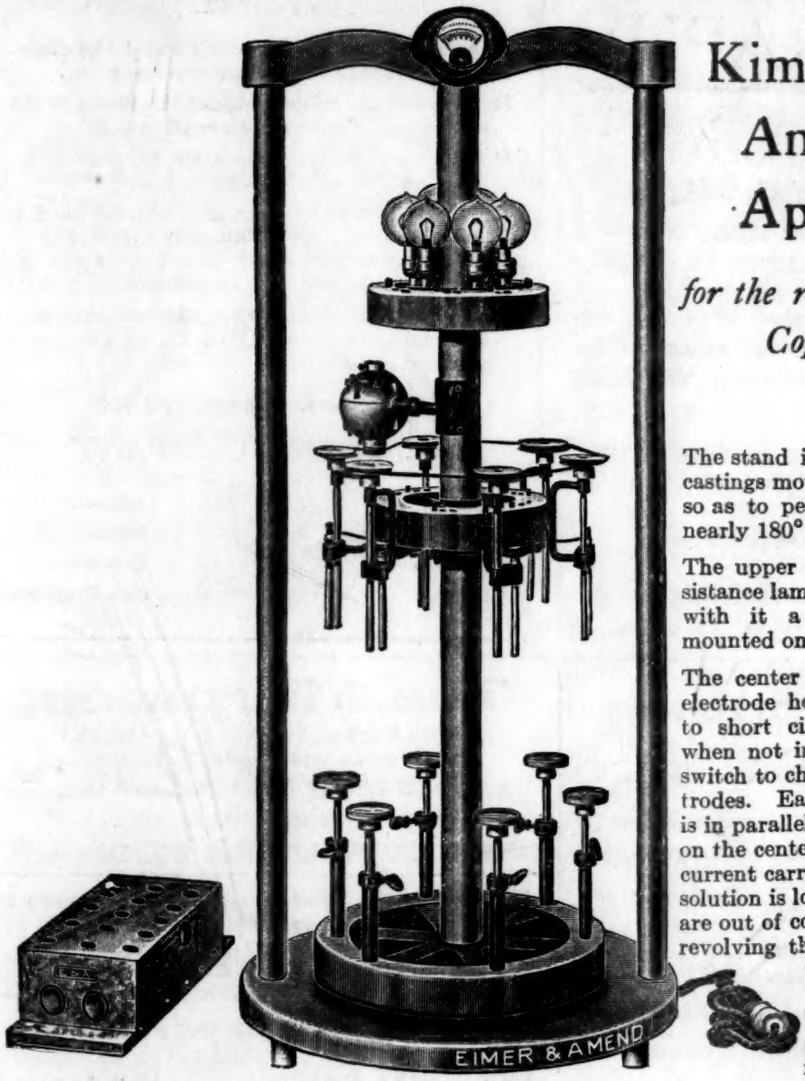

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SCIENCE

FRIDAY, OCTOBER 19, 1917

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THE UTILIZATION OF PATENTS FOR THE PROMOTION OF RESEARCH

ON September seventh of the current year an agreement was executed between Dr. T. Brailsford Robertson, professor of biochemistry and pharmacology, and the regents of the University of California, whereby the ownership of his patents covering the growth-influencing substance "Tethelin" which he has isolated from the anterior lobe of the pituitary body, and which, among other possible applications to therapy, promises to be of value in accelerating the repair of slowly healing wounds, was transferred to the University of California, upon the condition that the proceeds or profits which might accrue from their ownership of these rights should be devoted to the furtherance of medical research, such research to be conducted under the immediate direction of a board of directors constituted in the first instance of the undersigned individuals.

The proposal thus advanced by Professor Robertson and accepted by the regents of the University of California constitutes, we believe, a new development in the relationship of science to the industries, and of scientific investigators to the institutions employing them, and we believe that, as such, it should receive the serious consideration of the scientific public, entirely apart from the separate question of the possible merits of this particular invention.

The growing recognition of the intimate dependence of the industries upon science and the increasing complexity and requirements of scientific research itself, have led

many to the belief that some modification is desirable of the traditional relationship between the investigator and the material product of his discoveries. In the initiation of such changes, of which the present proposal is one among a number which might be suggested, many serious problems present themselves, and we feel that the solution suggested by Professor Robertson should be subjected to careful scrutiny and the fullest possible criticism. We have accordingly requested Professor Robertson to publish a statement of the fundamental conceptions underlying his proposal, together with the text of the agreement itself. Professor Robertson's statement follows:

H. M. Evans (Professor of Anatomy),
F. P. Gay (Professor of Pathology),
T. Brailsford Robertson (Professor of Biochemistry and Pharmacology),
C. L. A. Schmidt (Research Assistant in Pathology),
G. H. Whipple (Director of the Hooper Foundation for Medical Research and Professor of Research Medicine).

At the present time, as in the historic past, the scientific investigator looks to public or private generosity to supply him with the means of subsistence and the material prerequisites of his work. This relationship of the investigator to the public, while it has been unquestionably fruitful, is nevertheless fraught with many and serious disadvantages. To enumerate but a few of the more salient of these, the investigator is placed in a relationship of direct or indirect dependence upon his patron, a relationship which is not conducive to the best and most complete mutual understanding and appreciation. The income proceeding from these haphazard sources is of variable and unpredictable magnitude, and bears no necessary relationship whatever to the development of our material environment and the concurrent increase in complexity and proliferation in detail of scientific problems. The donors to a greater or less extent modify by their imperfectly informed preferences the channels of expenditure, so that the resources available for the development of any particular field of research are frequently disproportionate to its intrinsic importance.

It is obvious that a much more desirable condition of affairs might be attained if some automatic mechanism could be devised whereby a proportion (and a very small proportion would be sufficient) of the values created by scientific investigation would flow back to provide the material foundations of further discoveries, just as, at the present time, the intellectual foundations of fresh discoveries are automatically afforded by the information flowing in from the discoveries of the past.

A number of separate attempts to achieve this end have already been made, but while the results achieved have frequently been admirable in themselves, they have hitherto failed to afford any precedent which is generally acceptable to scientific men or to the institutions employing them. In some cases individuals have set aside a proportion of the proceeds from their inventions for the support of isolated scientific enterprises, the Solvay Institute in Brussels being a noteworthy instance of this type. In others an institution or an individual affiliated with the institution has entered the commercial field, selling certain articles manufactured in the laboratory, the proceeds from the sales being devoted to the upbuilding of the institution. Illustrious examples of this method of procedure have been afforded by Behring and by Pawlow. The objection to this

method lies in the fact that the efforts and attention of the individuals concerned are to a greater or less extent and more or less permanently deflected from their proper business of investigation and that certain dangers and abuses might conceivably arise from the too close identification of the individual and the laboratory in which he works with purely business enterprise.

In other instances, of which Ehrlich's disposal of the proceeds from salvarsan affords the most illustrious example, the discoverer has patented his invention, leased the patents to manufacturers, and dedicated the proceeds to the furtherance of a particular field of research, usually closely allied to the field from which the patented discovery arose. While the result of this procedure in the particular example chosen to illustrate it was in the highest degree successful, and the work accomplished by this means has been of incalculable value to humanity, yet, as a precedent, it has been felt by many that it presents several imperfections, notably that afforded by the association of an individual investigator with a particular business enterprise and the absence of any supervisory control over the commercial exploitation of the discovery.

The industrial fellowships which in recent years have been established in many institutions in the United States and particularly in affiliation with the Mellon Institute of Pittsburgh, represent another stage in the evolution of the relationship between the sciences and the industries. The industrial fellowship plan has proved to be far more widely acceptable as a precedent than any of the plans which I have heretofore mentioned. It is, however, more especially designed to be of direct service to existing industries, to bridge the gap between pure science and industrial progress and to meet the immediate needs of existing industries as they arise rather than to initiate new developments of science itself. Their purpose diverges, therefore, from that of the purely scientific investigator, and while they are of unquestionable value in the field for which they are designed, they leave unsolved the problem of providing automatic support for the development of the deeper foundations of industrial and social evolution.

A plan of wider scope, and applicable to the support either of the pure sciences or of industrial research was launched some years ago by my former colleague Dr. F. G. Cottrell, in the form of the Research Corporation of New York,[1] to which he donated certain of his patent rights in his electrical precipitation process. The certificate of incorporation of this company decares that its purposes are:

(*a*) To receive by gift and to acquire by purchase or otherwise, inventions, patent rights and letters patent either of the United States or foreign countries and to hold, manage, use, develop, manufacture, install and operate the same, and to conduct commercial operations under or in connection with the development of such inventions, patent rights and letters patent and to sell, license or otherwise dispose of same and to collect royalties thereon, and to experiment with and test the validity and value thereof and to render the same more available and effective in the useful arts and manufactures and for scientific purposes and otherwise.

(*b*) To provide means for the advancement and extension of technical and scientific investigation, research and experimentation by contributing the net earnings of the corporation, over and above such

[1] "The Research Corporation, An Experiment in Public Administration of Patent Rights," Eighth International Congress of Applied Chemistry, New York meeting, October, 1912, Vol. XXIV., p. 59.

sums as may be reserved or retained and held as an endowment fund or working capital and also such other moneys and property belonging to the corporation as the board of directors shall from time to time deem proper, to the Smithsonian Institution and such other scientific and educational institutions and societies as the board of directors may from time to time select in order to enable such institutions and societies to conduct such investigation, research and experimentation.

The efficient business administration which is thus provided and the separation of the scientific laboratories or investigators from responsibility for the administration of the funds and exploitations of the inventions combine to render the Research Corporation in many respects an ideal means of accomplishing the ends we have in view. It is impossible, however, for purely physical reasons, for the Research Corporation to handle all of the vast variety of profitable inventions, great and small, which issue or may come to issue from the laboratories of the United States, and it would obviously not be in the best interests of research to too greatly centralize the control of the means of its continuance and development. Some system is required which, like the Industrial Fellowship System, is indefinitely reproducible, and adaptable to all of the great variety of learned institutions which might desire to utilize it, so that the system may become an organic part of the investigator's environment and numerous foci come into existence from which the means for the furtherance of investigation may proceed. It was to provide a possible solution of this problem and a precedent which might be acceptable to other investigators and other institutions that the subjoined agreement between the regents of the University of California and myself was drafted.

There are highly profitable discoveries, of course, which are of such a nature as to demand expensive field-trials, or the expenditure of capital to ensure their successful flotation and protection during the period of tentative ultilization. The plan which I have to propose is not designed to deal with inventions of this type, but rather with the equally numerous inventions which are complete in themselves and ready to be leased or sold to existing commercial establishments. Public institutions, holding their funds on trust, can not, of course, enter into speculative enterpises. For dealing with discoveries requiring extensive initial expenditure and the flotation of new commercial enterprises to handle them, the Research Corporation and analogus corporations which may come to be founded for a like purpose provide an acceptable means of ensuring the adequate development of the invention and the return of the proceeds to the support of scientific investigations.

The fundamental administrative basis of the agreement which has been concluded between the regents of the University of California and myself consists in the provision for as complete a separation as is consonant with stability of the responsibility for the business administration of the trust and that for the actual performance of investigations financed from the proceeds of the trust. The successful scientific investigator is usually, for the simple reason of his success as an investigator, a very indifferent financier. The professional administrator or financier, whose interests and information are far removed from the battle-front of the conquest of nature, and whose preoccupation is rather the consolidation of conquests previously achieved, is usually a very in-

different director of scientific investigation. The truth of the former of these propositions will be admitted on every hand; that of the latter is not so generally recognized. It is, however, very clearly evidenced in many contemporary scientific enterprises which, under the too exclusive guidance of professional administrators, are comparatively inefficient in production of results of the highest intrinsic value, while the most successful scientific enterprises of our day are those which are being administered, so far as actual investigation is concerned, by men who are themselves practical investigators of distinction.

In the terms of the agreement it is provided that sole responsibility for every phase of the business administration of the patents and of the proceeds accruing therefrom rests with the regents of the University of California, while the proximate responsibility for the performance of investigations which may be financed by these proceeds rests with the board of scientific directors, under whose immediate direction, subject to the supervisory control of the regents of the university, all researches must be carried out. It is furthermore provided, in order to ensure that the personnel of the board shall consist exclusively of men in living touch with contemporary scientific problems, that the directors shall be persons themselves engaged directly and primarily in research work, and upon ceasing to be so engaged they shall be under obligation to resign as such directors, and if they do not resign their positions shall be declared vacant by the regents of the university. It is furthermore provided that the position of any director shall become vacant upon his attaining the age of sixty years, unless the regents of the University shall, for strong reason existing in the particular case, extend his term of office.

The conquest of nature, which is the material preoccupation of the scientific investigator, is not unlike a military campaign, in that those who retire from immediate contact with operations speedily lose the instincts which underlie and determine practical success. The scientific investigator who ceases to pursue active investigation and turns to administrative or other pursuits, sooner or later loses the intuitions which formerly led him to detect the weak spots in the defense which nature opposes to our inquiry, and that grasp of the field of investigation as a whole which actual contact keeps alive.

A true estimate of any professional man can only be formed by his professional colleagues, and it is therefore provided that any vacancies in the board of directors must be filled on nomination of the remaining members. Such nominees, however, must be approved by the regents of the university, and responsibility for the personnel of the board is thus shared in the fullest possible measure between the members of the board itself and the regents of the university. This provision, and the preceding provisions, are designed to obviate the notorious defects attaching to self-perpetuating boards, while introducing a just sufficient element of self-perpetuation to ensure the perpetuation of the essential character of the present board.

There is a very prevalent misunderstanding even among scientific men, of the true function of the protection extended by patents. While they are designed among other things to ensure a monetary return to the discoverer by granting him a temporary monopoly of his discovery, yet this is only one and not by any means the most successful feature of their purpose. As summarized by Dr. F. G. Cottrell, the basic reasons for granting patents are the following:[2]

[2] "Government Owned Patents," *Proceedings of the American Mining Congress*, Nineteenth Annual Session, Chicago, Illinois, November 13–16, 1916.

Firstly, to substitute a definite and regulated form of monopoly under the law for the broader and entirely unregulated one which the patentee might otherwise secure by retaining his secret.

Secondly, to encourage and stimulate invention.

Thirdly, to give adequate opportunity and encouragement for intensive commercial development of the invention which is almost invariably necessary to make it generally available on its own merits to the ultimate consumer.

Among medical investigators a very definite prejudice exists against the patenting of any medical discoveries, and this view is to some extent shared by not a few investigators in other fields. The fundamental instinct which leads to this aversion is unquestionably a sound one. It consists in the feeling that monopoly renders possible commercial exploitation, which increases the cost of the article to the consumer disproportionately to the cost of production, while among medical men the word "patent" arouses the repellant idea of the so-called, but mis-named "patent medicine." That notorious abuse is, of course, not patented and should correctly be designated the "proprietary medicine." If existing proprietary medicines were patented (and of course the vast majority, being merely recipes, would not be patentable) their most undesirable feature, that of secrecy, would be at once removed, since, in Great Britain and America at least, the issuance of letters patent is the completest and most accessible form of publication possible. As regards the objection to the feature of monopoly, it is to be recollected that letters patent are only one and not the most efficient among many methods of securing monopoly, and it may be questioned whether the non-issuance of patents would in any important degree lessen the average cost of medical articles to the ultimate consumer. It is, however, to be admitted that the possibility of outrageous extortion from the public does exist and has occasionally been realized in practise. In the subjoined agreement it is, however, provided (subdivision *a*) that the regents of the University of California undertake to utilize the rights granted to them in such a manner as will in their judgment best produce a monetary return and at the same time render the use of the preparation patented most generally available for the benefit of the human race. The regents of the university are thus clearly authorized, in event of their considering it to be desirable in the interest of availability of the preparation for the benefit of humanity, to deliberately sacrifice monetary advantage, and, the element of personal interest being entirely excluded, the public has the fullest procurable guarantee that they would, if occasion arose, take such action.

In subdivision *b* are contained clauses which provide for the reimbursement and "conditional insurance" of the donor. In this particular instance the reimbursement is confined to the repayment of actual expenses incurred, but in many other instances it might very properly consist in a sharing of profits, either expressed as a lien consisting of a cash sum or of a definite sum per annum, or as a percentage of the proceeds, or geographically, the patent rights in certain countries or localities being retained by the donor. The "conditional insurance" clause is inserted to forestall the obvious injustice which might arise were the surviving family of the donor to find themselves in actual need while the university might at that moment be reaping large returns from his discoveries. If, however, the university were to be compelled from the beginning to accumulate a fund to cover this contingency, the result might be, at least for a considerable term of years, to completely stultify the gift and

the purposes of the donor. In order to neutralize this it is therefore provided that the university shall not be required to make any provision for this purpose in advance of the actual event of the death or disability of the donor, and the claims of his survivors only become operative at the moment of his death.

In subdivision *c* are included certain individual preference-clauses which, collectively considered, must form an essential and very valuable part of any widely acceptable plan of this nature. In the first place the donor expresses his preference that the proceeds be expended in the furtherance of research on the physiology, pathology and chemistry of growth. This is expressed merely as a preference, however, and is not mandatory. It is merely equivalent to a consistent vote in a certain direction which may, if necessary or advisable, be outweighed by a majority of the votes of the board. It is felt by the writer that the expression of such preference in each and every case of the kind will help to automatically adjust the material resources of the different fields of scientific investigation to their current needs. The donor is usually likely to desire that the proceeds be appropriated to the support of a field of investigation which he considers to be, at that time, lacking in sufficient material support. Such preferences should not be rendered mandatory, however, for the reason that the condition which the donor seeks to rectify may turn out to be only temporary, or the intrinsic importance of the field may ultimately prove to be insufficient to warrant the expenditure of the entire proceeds upon it.

The donor also expresses his preference regarding the locality in which a proportion of the proceeds should be expended. This arises from his conviction that the welfare of scientific investigation, as a whole, demands the widest possible distribution of the facilities for conducting practical investigation.[3] At the present time in New York, London, Paris or Berlin the young man who has capability for original investigation has every opportunity of acquiring facilities for his work and of gaining inspiration from the example of investigations proceeding to a successful issue in his own vicinity and under his own observation. He sees in actual operation the methods of work adopted by masters of his subject, and examples and opportunity alike combine to make the path easy to his chosen career. But what shall we say of the opportunities of the young man or woman in Siberia, China, Australasia, South America or Africa? In certain localities in these countries every necessary institution exists for providing the essential preliminary training of the investigator, but, training in the fundamentals of his subject secured, where is he now to turn for the living example of the successful experimental investigator or for the opportunities of a large and abundantly equipped laboratory, partly or wholly devoted to research? The bare possibility of creating fresh fields of knowledge will probably never even occur to him, since he has never seen or been stimulated to imagine investigation conducted on a broad and practical scale. As a means of tapping new sources of talent for investigation a centripetal disposal of investigators and the opportunities for investigation has become a paramount necessity. The fact that the donor received his fundamental training in Australia determined the preference which he has expressed. It is not rendered mandatory, however, for the reason that it is not clear that the opportunity to so dispose of the proceeds in this particular instance will ever arise, or if it did arise, whether unforeseen political or other events might not, at some time in the fu-

[3] "The Strategics of Scientific Investigation," *The Scientific Monthly*, December, 1916, p. 547.

ture, render this disposal of the proceeds inadvisable.

In conclusion, although the plan incorporated in this agreement is applicable to any and all completely developed patentable discoveries which may be made by the employees of learned institutions, the board of directors herein created confines its functions to the administration of *medical* research. It was felt that it would be impossible to choose a board commanding the confidence of investigators in all the various fields of scientific research without making up the personnel by ex-officio appointments, as the dean of this or the professor of that particular college or subject, and thus introducing the very atmosphere of bureaucracy and officialism which it was sought to avoid. In event of this precedent being at all extensively copied it will obviously be necessary, for universities at all events, to establish three or four separate foundations and a like number of boards of scientific directors.

The text of the agreement follows:

T. Brailsford Robertson

This Indenture, made this 7th day of September, 1917, between T. B. Robertson, the party of the first part, and The Regents of the University of California, a corporation, the party of the second part,

Witnesseth:

Whereas the party of the first part is the discoverer of a medical preparation named Tethelin, covered by United States and British patents, and is the owner of such preparation and of such patents and of the trade-name "Tethelin,"

Now, Therefore, It Is Agreed as Follows:

I

The party of the first part hereby conveys and grants to the party of the second part the said preparation, patents and trade-name, and all his rights as the discoverer of said preparation and the owner thereof and of said patents and trade-name, upon the following trust, to wit:

(*a*) To utilize the rights hereby granted in such a manner as in the judgment of the party of the second part will best produce a monetary return therefrom and at the same time render the use of such preparation most generally available for the benefit of the human race. The party of the second part shall have the right to sell or dispose in any other manner of said rights or any of them, in whole or in part, or to grant subsidiary rights and privileges thereunder, either upon royalties or otherwise. The party of the second part agrees that it will use all reasonable diligence to utilize said rights as aforesaid, but it is particularly agreed, and the party of the second part accepts said trust only upon the condition, that it shall be the sole judge as to what is reasonable diligence in the respect mentioned, and that it shall not be pecuniarily or legally responsible for any want of diligence in such respect unless the same be in bad faith or the equivalent of bad faith, and that in view of the fact that the party of the second part is a public eleemosynary corporation all of whose funds are held upon other trusts, the party of the second part shall not be pecuniarily or legally liable under any circumstances whatsoever except to the extent of such rights or the proceeds, profits or returns thereof at the time of recovery against it in the hands of the party of the second part:

(*b*) To apply any proceeds, profits or returns from the utilization of said rights, after paying the expenses of the party of the second part in connection with the trust, to the reimbursement of the party of the first part in the sum of one thousand dollars ($1,000) for expenses incurred by him in making such discovery of such preparation, and, in case of his disability, to the payment to him thereafter for his life of the sum of five thousand dollars ($5,000) annually, and in case of his death to the payment of a like amount to his wife for her life, and in case of the death of both himself and his wife leaving a minor child or children, to the payment of a like amount to such child or children until such child or the youngest of such children shall have reached majority: provided, however, that such annuities shall each year be payable only out of such proceeds, profits or returns as may come in during that year and any balance on hand at the beginning of the year unexpended and unappropriated for the purposes mentioned in the following subdivision (subdivision *c*):

(*c*) To apply any unexpended balance of such proceeds, profits or returns to research work in medicine and preferably in the physiology, chemistry and pathology of growth either under the auspices of the University of California or otherwise, it being the wish of the party of the first part, but

not a condition, that in case such proceeds, profits or returns amount to a sum sufficient to justify it, such research work be conducted in part in Australia, either under the auspices of some institution of learning there or otherwise. The party of the second part shall direct such research work in consultation with the men hereafter named as the first members of the board of directors of the Institute of Medical Research whose creation is hereinafter provided for and their successors. The party of the second part shall have the right, subject to the provisions of subdivisions (*a*) and (*b*) preceding, to expend such proceeds, profits or returns on such research work either in whole or in part, holding and investing such accumulation as a fund and expending the income of such fund in the maintenance of research work:

PROVIDED, however, that in case at any time such proceeds, profits or returns are sufficient in the judgment of the party of the second part to justify it, it shall create an Institute of Medical Research which shall, under the immediate direction of a board of directors of five members subject to the supervisory control of the party of the second part, carry on and direct the work of research mentioned. Such Institute, if created, shall also be authorized to conduct other kindred lines of research with funds received or appropriated by the party of the second part for that purpose from other sources, and particularly from the utilization of other discoveries transferred by the discoverers to the party of the second part, provided that in case of conveyance to or acquisition by the party of the second part of other discoveries or patents or rights from which and from the discovery patents and rights hereby conveyed, come proceeds which are joint to both, the party of the second part shall be the sole judge as to the relative proportion of such joint proceeds as are attributable to each of the joint sources thereof. Such board of directors shall in the first instance be composed of F. P. Gay, H. M. Evans, G. H. Whipple, C. L. A. Schmidt, and the party of the first part. Any vacancy in said board shall be filled on the nomination of the remaining members approved by the party of the second part. The directors shall be persons themselves engaged directly and primarily in research work either of the character mentioned or of some kindred character, and upon their ceasing to be so engaged they shall be under obligation to resign as such directors, and if they do not resign their positions shall be declared vacant by the party of the second part and upon such declaration shall be vacant. The position of any director shall become vacant upon his attaining the age of sixty (60) years unless the party of the second part shall, for strong reasons existing in the particular case, extend his term of office.

II

The party of the second part accepts the foregoing grant and conveyance upon the trust above set out.

IN WITNESS WHEREOF the party of the first part has hereunto signed his name and the party of the second part has by its officers thereunto duly authorized hereunto signed its corporate name and affixed its corporate seal all on the day and year first above written.

T. BRAILSFORD ROBERTSON,

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA,

By WM. D. STEPHENS,

Governor of the State of California, and ex-officio President of the Regents of the University of California,

By V. H. HENDERSON,

Secretary of the Regents of the University of California

SCIENTIFIC EVENTS

JOSEPH YOUNG BERGEN

JOSEPH YOUNG BERGEN, author of several well-known text-books of botany and physics, died at his home in Cambridge, Mass., on October 10. Born at Red Beach, Maine, on February 22, 1851, he spent his youth in Ohio, where in 1872 he graduated from Antioch College, and where in connection with the State Geological Survey he performed his first scientific work. In 1876 he married Fanny Dickerson, who has collaborated with him in the production of several of his papers on evolution and Darwinism, and who herself has made notable contributions to the literature of American folklore. In 1887 Mr. Bergen became teacher of physics in the Boston Latin School and later for many years he was instructor in biology in the Boston English High School.

In 1891, in collaboration with Professor E. H. Hall, of Harvard University, he brought out "A Text-book of Physics." This had passed through subsequent editions in 1897 and 1903, and is still widely used in secondary schools.

His first biological text-book, "Elements of Botany," appeared in 1896 and its excellence was speedily recognized. With some modifications it was subsequently republished under the name of "Essentials of Botany," and in 1901 Mr. Bergen brought out his "Foundations of Botany," including a condensed flora for school use. Other text-books with special adaptation for schools of particular grades of scientific equipment were later published by Mr. Bergen with the collaboration of Dr. Otis W. Caldwell and Professor Bradley M. Davis.

By his long personal experience in the difficulties of the presentation of the subject of botany in the secondary school Mr. Bergen was able to frame these text-books in a way to meet both the needs of teacher and pupil and it is doubtful if any other texts have been more widely used or met with a greater success during the last two decades in the field which they cover.

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

The American Association of Variable Star Observers concludes this month six years of active service with a record of 15,763 observations of 332 variable stars for the year, and a grand total for the six years of 75,373 observations.

The past year has been one of marked progress in the efficiency of the scientific service rendered and growth in the membership of the association.

A meeting of the association will be held at the Harvard College Observatory, Cambridge, Mass., at 2 P.M., November 10. At this meeting a constitution and by-laws will be adopted and officers elected. Seventy-two observers have already enrolled as charter members and a cordial invitation is extended to all interested in the work to be present at the meeting. It will be a splendid opportunity to inspect through the courtesy of the director, Professor E. C. Pickering, the historic Harvard College observatory and to see exhibits of great interest to all astronomically inclined.

The undersigned will be pleased to answer any questions relative to the work of the association and will be glad to hear from any one who wishes to join the organization, and take up a line of telescopic work that is teeming with interest, devoid of mathematics and intricate detail, and eminently worth while.

William Tyler Olcott,
Corresponding Secretary
Norwich, Conn.

THE CORNELL MEDICAL SCHOOL

Cornell University Medical College opened its twentieth session on October 1, 1917. The student assembly was addressed by Dr. William H. Polk, the dean, who discussed the relation of the medical college to the present military situation and outlined the opportunities for patriotic service by students of medicine. The attention of the student assembly was called to the active participation in the work of the United States of America by the college, the members of the faculty and the medical graduates by active service in the field and by providing facilities for the instruction of officers of the Medical Reserve Corps. The entering students were exhorted to continue their course, that, in accord with the announced plan of the authorities, they may be prepared to fill the vacancies in the medical ranks which, with the continuance of the war, are certain to arise. The enrollment is as follows: First year, registered in New York, 38; registered at Ithaca, 30; total, 68; second year, 34; third year, 29; fourth year, 27; graduates in medicine, 4; total, 182. All students registered for the degree of M.D. (with the exception of those in the first year who are taking the seven-year course leading to the degrees of A.B. and M.D.), are graduates in arts or science. As a result practically all members of the first-year class fall within the limits of the military draft. Several students, having been drafted into the National Army, or fearing the draft in the immediate future, failed to register.

A SCHOOL FOR ORAL AND PLASTIC SURGERY

By order of the surgeon general of the army an officers' school for oral and plastic surgery has been established in St. Louis. The purpose of this new school is to train a

limited number of the medical reserve and perhaps other medical officers for the care of those peculiar wounds of the face and jaws characteristic of trench warfare. Both surgeons and dentists will enter upon this work and will eventually constitute a section of the staff in every base hospital and evacuation hospital in connection with the army. The plan involves the training and placing of a sufficient number to care for the face injuries presented among a million men in hospitals. Major Vilray Papin Blair, of St. Louis, has been called to Washington to organize and direct this important work. The first school has its headquarters at the Washington University Medical School, which at the beginning of the war offered to the government the facilities of its new laboratories, hospitals and clinics, and the services of its faculty. Instructors have been chosen chiefly from the faculties of Washington University Medical School and St. Louis University School of Medicine and the special curriculum has been adopted. The latter offers intensive work in anatomy, operative surgery, sepsis, anesthesia and dentistry. The first course will begin on Monday, October 15, and will extend over a period of three weeks to be repeated until the number of men desired has been reached. The surgeon general has designated for dean Dr. R. J. Terry, professor of anatomy in the Washington University Medical School, and for chairman of the curriculum committee, Dr. Hanau W. Loeb, dean of the St. Louis University School of Medicine; Dr. Ernest Sachs, associate professor of surgery at Washington University Medical School, to serve as secretary of the council.

THE RED CROSS MEDICAL SERVICE

THE establishment of a bureau of medical service of foreign commissions to give prompt and expert attention to the requests for medical and surgical supplies received from American Red Cross commissions now at work in France, Russia, Roumania, Italy, and Serbia is announced by the Red Cross war council. Requests for additional doctors and nurses for service with these commissions, particularly in France and Roumania, will also be handled by the new bureau.

In cooperation with the medical advisory board, the bureau will also render assistance in the solving of many new pathological problems constantly arising out of the war.

Dr. R. M. Pearce, of Philadelphia, professor of research medicine at the University of Pennsylvania, is director of the new bureau: Dr. W. C. Bailey, of Boston, associate director; and Dr. Ralph Pemberton, of Philadelphia, assistant. The secretary of the bureau is John Gilbert, of Philadelphia.

The growth of the work of all the Red Cross commissions in European countries during the last two months made the establishment of this bureau necessary. Drugs and medical supplies to the value of more than $500,000 have already been shipped to Russia, while three detachments of child specialists have been recruited throughout the country for service with the new children's bureau of the Red Cross in France. The bureau is furnishing bacteriologists, chemists, surgeons, and others for Red Cross establishments in Paris.

SCIENTIFIC NOTES AND NEWS

THE chairman of the committee on policy of the American Association for the Advancement of Science has requested Professor Cattell to continue to edit SCIENCE until the questions involved have been carefully considered by the committee on policy and the council of the association.

AT the annual meeting of the national advisory committee for aeronautics held recently, Dr. W. F. Durand was reelected chairman and Dr. S. W. Stratton was reelected secretary. Members of the executive committee were elected as follows: Dr. Joseph S. Ames, Dr. Charles F. Marvin, Dr. Michael I. Pupin, Major General George O. Squier, United States Army, Dr. S. W. Stratton, Rear Admiral D. W. Taylor, United States Navy, and Dr. Charles D. Walcott. At the organization meeting of the executive committee Dr. Charles D. Walcott was elected chairman and Dr. S. W. Stratton, secretary. Existing subcommittees were continued, and an editorial

committee was appointed to prepare for publication the technical reports.

Major George E. deSchweinitz, Medical Reserve Corps, has been assigned to active duty at Philadelphia for the purpose of compiling a handbook on ophthalmology for the use of the surgeon-general of the army.

Frederick B. Mumford, dean of the Missouri College of Agriculture, director of the experiment station of the University of Missouri, and chairman of the Missouri council of defense, has been chosen federal food administrator for Missouri.

The deputy-controller for auxiliary shipbuilding, of the British admiralty, has appointed Lieutenant-Colonel J. Mitchell Moncrieff to be director of engineering work, to deal generally with all civil engineering matters which may arise in connection with his department.

The post of director of food economy at the Ministry of Food of Great Britain has been undertaken by Sir Arthur Yapp, the national secretary of the Y. M. C. A.

Among the members of the faculty of the University of California Medical School who have been called into active service in the Medical Officers Reserve Corps are Dr. Herbert C. Moffitt, San Francisco, professor of medicine and dean of the medical school, who has been commissioned major, and stationed at the Army Hospital at San Antonio, Texas; Dr. Eugene S. Kilgore, who has been commissioned major, and is stationed at the Presidio in San Francisco; Dr. Alanson Weeks, instructor in surgery, commissioned major; Dr. Howard E. Ruggles, assistant clinical professor of roentgenology, and Dr. Jule B. Frankenheimer, instructor in medicine, commissioned captains; and Drs. Elbridge J. Best, Frank P. Brendel, Arthur C. Gibson, Charles L. Tranter and Daniel W. Sooy, commissioned first lieutenants.

The faculty of applied science of Columbia University has lost, temporarily at least, many of its officers, who are now engaged in government work. Professors Moss, Sleffel, and Thomas, of the department of mechanical engineering, and Mr. Mason, of the department of electrical engineering, are instructors, with the rank of lieutenant, in the naval reserve, in the naval engieering school conducted on the campus; Professor Arendt, of the department of electrical engineering, is in charge of electrical instruction at the submarine base at New London; Professor Webb, of the department of physics, is a captain in the Signal Corps; Dr. Thomas, of the department of chemistry, and Dr. Burwell and Mr. Brown, of the department of sanitary engineering, are in the sanitary corps of the army; Professor Beans, of the department of chemistry, and Mr. McGregor, of the department of civil engineering, are in charge of chemical and mechanical tests for the Aircraft Production Board; Professor Campbell, of the department of metallurgy, is consulting metallurgist for the navy, and Professor Walker, of the department of metallurgy, is in the ordnance department of the army.

The Maryland Geological and Economic Survey Commission, which consists of the governor of the state, the presidents of the Johns Hopkins University and the Maryland Agricultural College, and the state comptroller, has elected Professor Edward Bennett Mathews, for many years assistant state geologist, as state geologist to succeed the late Wm. Bullock Clark.

As a war emergency measure the National Forest ranges are carrying this summer approximately 100,000 more cattle and 200,000 more sheep than in ordinary years, according to the grazing experts of the forest service. Ordinarily the National Forests furnish pasturage for about 1,800,000 cattle and horses and 7,800,000 head of sheep. The number of livestock permitted on the forests is limited in order to prevent damage to timber growth, water supplies and the range itself. This year exceptional weather conditions combined with the general food situation to create an unusual emergency, calling for special provisions to take care of the stock. A severe winter and late spring exhausted the hay supply and forced use of the spring ranges before they had reached their normal state. To lessen the

losses which the western livestock industry faced, the National Forest ranges were opened early. At the same time, the number of stock permitted for the present season was raised to the maximum consistent with safeguarding future productiveness. It is fully recognized that the increases which have been made in the allowances of stock on the national forests involve danger that the range will be depleted through overgrazing, but it is believed by the grazing experts of the government that the emergency increases made can be taken care of, at least this year, without material sacrifice of productive capacity. The condition of the ranges is, however, being carefully watched. Reliance is placed also on the special efforts being made to secure the most intensive utilization consistent with sustained productiveness, by improved methods of handling the stock. Better salting methods and the development of new watering places are among the means employed for this purpose. At the close of the grazing season a careful examination will be made of the range on each forest to determine its condition and to find out how many cattle or sheep it will support next season. On areas which are found to be overgrazed, an attempt will be made to shift the surplus stock to range which can stand the strain better. While the grazing officials do not think that the increase could be carried indefinitely without serious damage to the forage, regulated grazing has brought about a steady improvement of the range and some areas will probably be able to support the larger numbers permanently.

DURING the last week of September nine industrial fellows of the Mellon Institute of Industrial Research entered the service of the government. The names of these men, all of whom are chemists, are as follows: Dr. Frank O. Amon, Dr. Harold S. Bennett, Mr. A. S. Crossfield, Mr. W. J. Harper, Mr. C. E. Howson, Dr. R. W. Miller, Mr. Ray V. Murphy, Mr. W. E. Vawter and Mr. C. L. Weirich. Messrs. Amon, Bennett, Howson, Miller, Murphy, Vawter and Weirich have received commissions as first lieutenants. In addition, three other Industrial Fellows, Messrs. C. O. Brown, G. F. Gray and R. P. Rose had previously been commissioned as captains; A. H. Stewart has entered the aviation service and C. N. Ivy has been appointed a second lieutenant in the Engineering Corps.

THE dean of Sibley College, Cornell University, Professor Albert W. Smith, has received leave of absence for the year 1917–18 in order that he may serve as consulting engineer to the Mathieson Alkali Works at Saltville, Virginia. Professor Dexter S. Kimball, head of the department of machine design and industrial engineering, has been appointed acting dean of Sibley College.

PROFESSOR J. C. BRADLEY, of Cornell University, and Professor Edwin C. Van Dyke, of the University of California, have exchanged work for the current year. Although both are general entomologists, Professor Van Dyke is an authority on the coleoptera, while Professor Bradley is a specialist on the hymenoptera.

PROFESSOR JOHN C. MCLENNAN, Ph.D., head of the department of physics of the University of Toronto, and member of the Canadian Commission on Chemical Research, is among the first group to receive the honor of the new Order of the British Empire.

THE Medical Club of Philadelphia will give a reception in honor of Dr. Morton Prince, of Boston, on October 19, at the Bellevue-Stratford Hotel.

DR. SANTOS FERNANDEZ, president of the Cuban Academy of Science, and one of the most distinguished eye surgeons of Cuba, was the guest of honor at a luncheon given October 2, by Dr. William Campbell Posey, of the Wills Eye Hospital, Philadelphia.

ACCORDING to *Nature*, the seventieth birthday of Professor S. Hoogewerff, formerly rector of the Technical High School of Delft, was recently celebrated by his friends and pupils. Professor Holleman briefly reviewed Hoogewerff's work, carried out conjointly with the late Dr. Van Dorp, on the cinchona alkaloids, on isoquinoline, and on the production of anthracilic acid from phthalimide. The latter reaction became a step in the manufacture of synthetic indigo. On behalf of a

number of Dutch chemical firms, Dr. Van Linge, manager of the Maarssen quinine works, announced that more than £8,000 had been subscribed for the foundation of a prize for chemistry at the Technical High School at Delft, in order to commemorate Professor Hoogewerff's services to this institution and to Dutch chemical industry.

Having completed the report upon the geology of southern California for the U. S. Geological Survey upon which he has been engaged for several years past, Robert T. Hill has opened an office for the practise of his profession of geologist at 702 Hollingsworth Building, Los Angeles, Cal.

Mr. W. H. Fegely, for several years instructor in chemistry and assistant director of the laboratories at Allegheny College, has resigned his position to take charge of the research laboratories of the Erie Malleable Iron Company, Erie, Pa.

Shirley W. Allen, of the extension department of The New York State College of Forestry at Syracuse University, has been appointed, temporarily, to suceeed Victor A. Beede as secretary of the New York State Forestry Association. Mr. Beede has gone into forest fire insurance work at Portsmouth, N. H., and Mr. Allen will act as secretary until the midwinter meeting to be held some time in January, 1918.

Professor J. A. Fleming delivered a public lecture on "The work of a telephone exchange" at University College, London, on October 17.

The death is announced, at fifty-six years of age, of Mr. R. D. Pullar, president of the British Society of Dyers and Colorists in 1914, and chairman of the well-known firm of Messrs. J. Pullar and Sons, dyers and cleaners, at Perth. Mr. Pullar was a life fellow of the Chemical Society of London.

The death is also announced of A. da Graça Couto, professor of ophthalmology at the University of Rio de Janeiro and director-general of the public health service, aged fifty-three.

The Evening Post says that France presents the interesting spectacle of a country in which three of the most important posts in government and army are filled by men whose qualifications include a remarkable proficiency in mathematics. The new Premier, M. Painlevé, was as precocious as a Pascal in that branch of knowledge, says the *Christian Science Monitor*. He knew enough at eleven and a half to have got his bachelor's degree, and later on he was a cause of amazed admiration to no less a person than Henry Poincaré. Then there is the commander-in-chief General Pétain, whom M. Painlevé, when Minister of War, chose to lead the French armies in the final and perhaps most difficult stage of the war. He also is a fine mathematician. Finally there is M. Loucheur, the new minister of armaments, and he did nothing less while at the Ecole Polytechnique than discover a new theorem on epicycloids. This is more than coincidence, it is significant of the direction in which the new France intends to travel.

The Engineering Corps is looking for 10,500 men with road-construction experience to serve in an engineer brigade which is soon to go to France to do roadbuilding work with General Pershing's expeditionary force. The regiment will be made up entirely of volunteers. No man actually called for military service is eligible. Rapid advancement is promised men with special qualifications, and a few college men, preferably with military experience, are wanted as non-commissioned officers.

The *Journal* of the American Medical Association states that the Swiss Société helvétique des Sciences naturelles, which was the original model on which Virchow founded the German organization which meets once a year for what are popularly called the *Naturforscher* congresses. The venerable Swiss association now announces the formation of a section or subsociety devoted to medical biology, to be known as the Société de Médecine et de Biologie. Professor Hedinger of the University of Basel is the moving spirit in the matter. The inaugural meeting is to be held this month at Zurich. It is hoped for a large membership among physicians interested in medical biologic questions.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of Mrs. E. D. Denning, of Norwood, London, who left an estate of the gross value of £167,719, there is bequeathed "to the Public Trustee all her freehold property in trust for a 'Frank Denning Memorial' for the advancement and propagation of education in mechanical science in any part of the United Kingdom, with preference to those persons who reside in the Borough of Croydon."

ENGLISH exchanges report that Lord Lovat, Mr. Otto Beit and Mr. Rudyard Kipling have accepted the positions of trustees under the will of the late Mr. Cecil Rhodes in succession to Lord Rosebery and Sir Lewis Mitchell, who resigned recently, and of the late Earl Grey, who had resigned shortly before his death. The trustees have decided to allot the four new scholarships created in substitution for the scholarships formerly held by Germans to the provinces of Alberta and Saskatchewan, to the Transvaal, to the Orange Free State and alternately to the towns of Kimberley and Port Elizabeth in the Cape Province. As Alberta and Saskatchewan have hitherto had one scholarship between them, the effect of this decision will be that each of these provinces will now have a scholarship. The trustees have decided not to make any appointments to any scholarships this year, either in the United States or in any part of the British empire, although the qualifying examinations in the United States will be held as already arranged. This decision is based upon the fact that as all candidates must be men of military age it would not be in accordance with the spirit of the testator's design if young men who first responded to the call of patriotism were to be penalized for having done so. Any candidate who is eligible this year will be equally qualified for election next year.

No successor to the late Professor Wm. Bullock Clark will be appointed at the Johns Hopkins University. The geological department has been reorganized on a committee basis with Professor Edward Bennett Mathews as chairman and Associate Professor J. T. Singewald, Jr., as secretary. The instruction formerly given by Professor Clark has been divided among the geological faculty, Professor Edward W. Berry taking his work in paleontology and historical geology.

AT Pennsylvania State College, David Allen Anderson has been chosen professor of education and head of the department of education and psychology. Dr. Anderson was previously associate professor of education in the University of Washington.

PROFESSOR GEORGE B. MCNAIR is acting head of the department of electrical engineering of Colorado College during the absence of Professor George B. Thomas.

DR. WILLIAM SHINER, superintendent of the pathological laboratory of the Indiana State Board of Health, has been offered the professorship of pathology in the University of Texas.

DR. SAMUEL A. MATTHEWS, professor of physiology and experimental pharmacology in the University of Kansas, Topeka and Lawrence, has accepted the similar chair in the University of Alabama, Mobile.

DR. FRANCIS M. VAN TUYL, formerly instructor of geology in the University of Illinois, has recently been appointed an assistant professor in the Colorado School of Mines, at Golden.

BERNARD A. CHANDLER, of the Vermont Agricultural Experiment Station, has been appointed assistant professor of forest utilization in the department of forestry of Cornell University.

W. G. BRIERLEY, chairman of the division of horticulture, department of agriculture, University of Minnesota, has been promoted to the rank of associate professor.

DR. FLORENCE PEEBLES, professor of biology at Newcomb College, Tulane University, has been appointed associate professor of physiology at Bryn Mawr College.

DR. J. LUCIEN MORRIS, formerly associate in biological chemistry at the Washington University Medical School, has accepted the position of associate in physiological chemistry at the college of medicine, University of Illinois.

A CHAIR of tuberculosis has been instituted by the Edinburgh University Court, and Sir

Robert Philip has been appointed as the first professor of the subject.

DISCUSSION AND CORRESPONDENCE

ISOLATION CULTURES WITH SMALL AQUARIA

When raising small forms of vegetable or animal aquatics, it is sometimes desirable to follow the development of several individuals simultaneously, and for some considerable time. This can done of course by removing the specimens to separate small aquaria, but by so doing the temperature and other conditions are likely to offer a considerable range of variation among the different specimens. This invites uncertainty as to the natural rate of development, or in response to any intended variable introduced by the experimenter. The desirable condition is to combine a considerable volume of water with isolation of individuals so that each specimen may have essentially identical conditions of temperature, and concentration as each other, in groups of eight to twelve individuals.

During a study of *Lemna* carried on for several months, it was desired to isolate individual plants in order to watch the rate of growth. As the frond floats freely, some method by which the surface of the water could be enclosed in distinct areas seemed likely to meet conditions. It was found that common cotton cord, waxed with parafine, and tied into loops two inches in diameter, were excellent for this work so long as the water was undisturbed. Any disturbance, however, either accidental or in course of the work, by which the upper surface of the string loops become wet, made these sink quickly after they had been in use two or three days, and the enclosed specimens would then be confused with any others which might be near. Small snails developing in pond water used were quite a source of loss of specimens by their destructive habits, as well as factors of uncertainty, through the displacement of the string loops, drawn below the surface by the movement of the snails in case these crawled across the strands. The vessels used at this time were common glass battery jars, and served very well in keeping the plants in good condition, but they were unnecessarily deep.

Later work was done with large crystallizing dishes, and the separation of individuals was secured by the use of glass dehydrating dishes with short legs and perforated bottoms, for inside dishes. This was found very satisfactory. The volume of water in the crystallizing dish was large enough to retain a much more steady temperature than did the small separate dishes tried for a time, and the perforated walls of the enclosing inner dishes permitted the movement of the water with sufficient freedom to eliminate any variable concentration or composition.

In securing single specimens for the isolation work, some interesting conditions were encountered on account of the toughness of the water film. It was found difficult, for example, to lift a single specimen of *Lemna* or *Wolffia* because the surface film would drag several additional specimens along with the desired individual. This trouble was largely eliminated by giving a smart puff of breath close to the desired specimen, which would cause a general scattering of all the floating particles from that point. As the elasticity of the film was released upon the cessation of the blowing, the dispersed specimens were drawn inward toward the center of the cleared area. On account of size, root development or other causes, the different specimens did not move with equal speed, and any one of the specimens first entering the cleared space could be lifted and removed with ease. It was found that a lance-head needle was an excellent lifter for the specimens.

Of three species under observation, *Wolffia* was the easiest to thus isolate, *Lemna paucicostata* next, and *Spirodella* the most difficult to lift with certainty. This is because *Wolffia* is completely immersed in the slight amount of water adhering to the needle, and sticks closely as this is raised from the dish. The single root of *Lemna,* and the many roots of *Spirodella,* prevent the fronds of these plants from so closely adhering to the flat needle. and their added weight also is adverse. It was found further that a dry needle was far

more satisfactory than one which was wet when introduced into the dish. The water on the needle would promptly unite with the surface water in the dish, and several specimens would then be lifted from the dish in nearly every case, unless previously puffed away with the breath. But by wiping the needle, the individual plant desired can often be lifted out even if others are so near as to nearly touch the selected plant.

The dehydration dishes within the crystallizing pans proved very satisfactory, and permitted the continued cultivation of the particular strain under observation for a considerable period.

FREDERICK H. BLODGETT

TEXAS AGRICULTURAL AND MECHANICAL COLLEGE, COLLEGE STATION, TEXAS

TWO METHODS OF ORIENTATION OF SMALL OBJECTS IN PARAFFIN

THE following method is applicable to all objects which are sufficiently small to admit of embedding in watch crystals. It has been found practical and easy and is given here in the expectation that it will be of assistance to others.

Watch crystals of the Syracuse type with flat bottoms are employed. On the bottom, parallel lines about 2 mm. apart are ruled with a diamond. These are then scraped out with a coarse needle, the sharp edges being broken off and the lines widened to form open grooves. The watch crystals should be washed to remove the small particles of glass and are then ready for use. The watch crystals are prepared for embedding by coating the interior with a film of glycerin as usual, but care must be taken to rub the glycerin into the lines. When infiltration is complete, the watch crystal containing the objects is removed from the oven and the bottom slightly chilled by contact with cold water. It is then placed on the stage of a binocular microscope and the objects oriented with a warm needle, so that the plane of section desired shall be parallel with the lines and normal to the bottom of the watch crystal. As soon as the paraffin on the bottom has cooled sufficiently to hold the objects in place, the entire mass is cooled with water in the usual manner. In orienting the objects it is found that the lines on the bottom of the watch crystal show more distinctly by transmitted than by reflected light. The block when removed shows on its lower surface minute parallel ridges which enable accurate and easy orientation when mounted on the object carrier of the microtome. The block should of course be placed in the microtome with the ruled surface upwards and then arranged with the lines parallel with the edge of the knife and the surface at right angles to the direction of motion, that is horizontal in the ordinary vertical type of Minot microtome, vertical in the horizontal type.

A second method, or variation of the method given above, is to rule the parallel lines on the watch glass with a "china-marking" pencil. These lines, even though the glass is thoroughly coated with a glycerin film, will come away with the paraffin block and may be used as orientation lines. This method may also be used for numbering or otherwise marking paraffin blocks.

JAS. A. NELSON

BUREAU OF ENTOMOLOGY, WASHINGTON, D. C.

THE AURORA BOREALIS

TO THE EDITOR OF SCIENCE: The display of the aurora borealis mentioned by your correspondent, Mr. Thomas Byrd Magath, in SCIENCE, No. 1186, as seen at Fairport, Ia., on the ninth of last August at about 8.45 (Central time?) was also observed by the writer and others from a yacht anchored at Thimble Islands (Stony Creek), Conn., at about nine, 75th meridian time, of the same evening. The display was quite brilliant, although the streamers did not reach much above 50° in altitude. The region of greatest brilliancy was about N. 25° W., true.

On August 14 at about the same time a more brilliant display was seen at Stonington, Conn. (Lat.41° 19′). The illumination reached much further to the eastward and the streamers were higher. At times masses of pale light detached themselves from the general illumi-

nation and rose with a quivering flame-like motion almost to the zenith where they disappeared, to be succeeded by others in turn. These waves appeared to be about 10° to 30° in a horizontal direction and perhaps 2° in the vertical direction. The display was observed by us until about ten and we were told by a fisherman who was out all night that it lasted until nearly three in the morning.

On August 25, at Clinton, Conn. (Lat. 41° 17′), we observed a still more brilliant display at 8.40. There was an arch of greenish-white light whose center bore nearly north, true, the portion of sky enclosed by the luminous arch being entirely dark. Streamers of considerable intensity were observed and the light from the arch was sufficient to illuminate the whole bay, rendering objects 300 yards away distinctly visible. At times above the greenish-white light, light varying from pale pink to deep red was observed, but chiefly on the eastern side of the meridian and high up, at least 75°. Suspecting that the latter phenomenon might be an illusion due to a complementary after-image of the brighter display lower down, we examined it carefully with the light from the rest of the display cut off for a considerable time but could not see that this made any difference. The display was observed until 9.40, when it had not ceased.

Are not these phenomena, *i. e.*, the dark segment below the bright arch and the pink color, unusual in such low latitudes?

Charles A. Mead

Carteret Academy,
Orange, N. J.

SCIENTIFIC BOOKS

Experimental Pharmacology. By Dennis E. Jackson, Ph.D., M.D., Associate Professor of Pharmacology, Washington University Medical School, St. Louis. St. Louis, C. V. Mosby Company. 1917. Pp. 536, with 390 illustrations. Cloth. Price $4.

Scientific text-books may be conveniently grouped into two classes: the majority have for their object the adequate, concise and clear presentation of the principal facts and data concerning the subject they deal with, in logical order and with a due regard to their relative importance. Such works are generally impersonal in character and introduce the author's views only incidentally in connection with the sections dealing with the particular lines of work in which they have been interested. Another class of text-books, however, may be characterized as distinctly "individualistic" in style and seem to have for their purpose primarily the exposition of the author's methods and views, relegating all other matter to a secondary place. Such a presentation of the subject is perhaps a natural one for the pioneer in a new domain of science and may be exemplified in case of pharmacology by Schmiedeberg's well-known little book, but when a science has once reached a high development, as is true of the pharmacology of the present day, this form of treatment in any hands but those of a great master is apt to become somewhat one-sided and provincial.

Within the last few months we have seen the publication in this country of two text-books on pharmacology which well exemplify the two classes just mentioned. Sollmann's "Manual of Pharmacology and Laboratory Guide"—the recent new edition of his older work, greatly amplified, revised and rearranged—is an excellent example of scientific exposition belonging to the first or "impersonal" class.

Jackson's "Experimental Pharmacology," on the other hand, is certainly "individualistic" in character, and must be put in the second class described above. It is not an ordinary "text-book" of pharmacology but is preeminently *Jackson's* text-book of pharmacology. The personality of the author is patent on almost every page of it; and therein are expressed both the merits and the demerits of the work. On the one hand, even a superficial examination of the treatise reveals, as is well known, that the author is a master of technique and the descriptions of various devices and experiments originated or improved by him are, in so far as they are new, illuminating and useful. On the other hand, the author unfortunately, in exactly the same manner as he treats new and original manipula-

tions, also expatiates upon non-essentials and indiscriminately devotes a great deal of valuable space to detailed and minute descriptions of ordinary experiments well known to every physiologist and pharmacologist, conveying the impression as if the methods taught by the St. Louis school were the only and the best.

The mass of unimportant details which are crowded into the book is surprising and it is doubtful whether they will prove profitable even to the student. It is a truism that no experimental science can be learned from a text-book and it is inherent in the nature of experimental investigation that subordinate details of various procedures have to be modified under various circumstances and conditions. It is very doubtful, therefore, whether pages of detailed description of *every* step in a given experiment may lead to a better grasp of its general features. Indeed, such didacticism may endanger the principal purpose of the exercise by diverting the student's attention from the main features of the problem. Many minutiæ should be best left to the common sense of the experimenter, and will be learned by the beginner on the first day he spends in the laboratory. A single demonstration in the lecture room or the workshop will teach the student more than a hundred pages of detailed description. For this reason long descriptions with illustrations of how to tie an animal on the operating table and similar incidental and trite matters seem to us trivial and entirely superfluous. Such directions might possibly be found useful by a self-made pharmacologist on an isolated island—a Robinson Crusoe with pharmacological tendencies—with no one to guide him, but are needless and purposeless in a country where good teachers are to be found and well-equipped laboratories are accessible.

The title "Experimental Pharmacology" as applied to the present work seems to one familiar with pharmacological text-books to be somewhat misleading. One unconsciously expects to find a work along the lines of the "Experimentelle Pharmakologie" of Meyer and Gottlieb, namely, a logical presentation of important pharmacological facts based upon the best modern experimental data. Jackson's book is in reality a laboratory manual which aims to present pharmacological deductions in connection with typical experiments described by the author. This fact explains best the rather one-sided character of the work, for in presenting the subject the author has laid the greatest stress upon the experiments in which he is an adept, and along the lines in which he has been personally interested. Thus, for instance, the whole group of heavy metals (iron, mercury, arsenic, etc.) is practically untouched in the text-book: they are not even mentioned in the index. On the other hand, the comparatively unimportant minor element or metal, vanadium, with which the author has done some work, receives considerably more attention than it deserves.

An extraordinary feature of Jackson's "Pharmacology" is its wealth of illustrations. The book is listed to contain 536 pages, including 390 illustrations. As many of the cuts are full-page, the drawings occupy about half of the book. Some of these are well executed and should prove extremely useful. This is especially the case with the reproductions of careful and complicated dissections and various schematic illustrations of nerves, blood vessels and other structures with which the book abounds. Furthermore, the drawings of new and original methods for studying circulation, pulmonary pressure, anesthesia, etc., will also be found of help. The diagram of the involuntary nervous system (p. 385), however, is not as lucid and explicit as that of Langley or the modifications of the latter to be found in Meyer and Gottlieb's "Pharmacology." A large number of kymographic tracings are also a distinctive feature of the book, but here again the author's personality is perhaps unduly accentuated by their selection. Thus we have noted some twenty or more tracings scattered promiscuously throughout the book, which illustrate broncho-constriction and broncho-dilatation, a method of experimentation for which the author has become well known. While many of the illustrations are well chosen and instructive, a large number may be found interspersed among them

which we deem entirely superfluous. We fail to discern the purpose served by pictures of a "graduated cylinder," a "beaker," a "burette and rubber tubing," a "specimen jar," "small wooden tables," a "casserole," a "scalpel," a "hemostat," an "evaporating dish," or of clamps, forceps, screws, scissors, oxygen tanks, hand bellows, bottles for holding stock solutions, and similar common utensils with which every student and laboratory boy becomes familiar as soon as he enters the class-room. Such illustrations could be obtained at a much less expense, if need be, from any laboratory supply dealer, by writing for an illustrated catalogue.

Barring the unnecessary mass of subordinate detail in the text and illustrations, Jackson's treatise has certain admirable features. The style of the author bespeaks his intense earnestness of purpose and interest in the subject. The descriptions of his original or improved methods are often admirable and illuminating. A number of experiments are described which are not found in the ordinary text-book. Among these may be mentioned especially experiments on the eyes, intratracheal insufflation, elaborate and newer methods of anesthesia, oncometric and other experiments on the spleen and other organs, methods for the study of esophageal, vesical and uterine contractions, and the author's *chef d'oeuvre*—his ingenious methods of studying pulmonary conditions, namely, pulmonary circulation, pulmonary pressure, and the contractions of bronchioles. Altogether, Jackson's "Pharmacology" is a unique and interesting work and will be found helpful by the pharmacologist, especially in the execution of some particular kind of work.

David I. Macht

Pharmacological Laboratory,
Johns Hopkins University

APHIS IMMUNITY OF TEOSINTE-CORN HYBRIDS

Certain properties and functions are possessed by some plants and animals providing them exemption from disease. The use of the word disease as applied to plants is sometimes restricted to bacterial and fungous parasitism and its effects. It is also sometimes applied to disorders brought about by various forms of malnutrition, including attacks by insects and other low forms of animal life.

When the favorable conditions of life are so seriously interfered with by any agency, so that the life of a part of a plant or of the whole plant is threatened, we recognize disease in that plant.

When a plant is able to repel such devastating forces, more or less completely, it is said to possess corresponding degrees of total immunity.

Plants and animals are also subject to depredatory attacks of small animal life, parasitic in nature, but not producing what is ordinarily conceded as organic disease. Certain individuals repel or resist such depredations and it seems proper to call this phenomenon immunity.

It is with a behavior belonging to the last-named category that this account is concerned. The appearance of an instance of total immunity of any kind in an economic plant or animal seems eligible to record, and especially when the immunizing factor is hereditary.

During the early summer of 1913 there were grown in a greenhouse four short rows of F_1 or first generation hybrid plants coming from seed produced by fecundating teosinte, *Euclanea mexicana* with pollen of yellow dent corn, *Zea indentata*.[1] In the same bed, and immediately adjoining the hybrid rows, were grown one row of the parent strain of teosinte on the one side and four rows of the parent strain of corn on the other.

[1] Teosinte and corn are both members of the grass family, but are classed in different genera. They hybridize freely with each other, although the teosinte is decidedly grasslike in appearance producing small two-rowed fruiting spikes in marked contrast to ears of dent corn. The first hybrid generation is intermediate in structure between the two parents, but more nearly resembling the teosinte in tillering profusely and being tall, slender and foliaceous. The hybrid ears are also small, fitting rigidly into a cavity of an internode of the rachis which disjoints readily at maturity, but succeeding generations produce some larger fruiting spikes more like the dent-corn parent.

As the spring season advanced several species of ants began visiting this bed. Later, colonies of aphis were found upon the roots of the corn, and finally heavy infestations upon the upper parts of a number of the corn plants. During four months of almost daily scrutiny no aphis was ever discovered upon either the teosinte or the hybrids. Ants were noticed occasionally upon these plants but their visits were apparently fruitless. A dozen or more hills of teosinte had been grown in 1909 and again in 1910 in cornfields heavily infested with aphis, but none had been noticed on the teosinte, although no particular attention was given to this question at the time.

The colonies of aphis in the greenhouse were sprayed effectively at intervals, but new colonies again appeared on the corn. It is well known that corn plant aphis, when not in the winged state of metamorphosis, frequently depend upon ants for transportation over short distances, *e. g.*, from one plant to a neighboring plant, as well as from one region to another on the same plant. The ants act as herders and protectors of the aphis, taking their toll in the sweet sticky fluid secreted by the aphis. The aphis are moved to a new feeding spot or pasture when the supply of fluid is not satisfactory to their herders.

The occasional appearance of ants searching over the teosinte and hybrid plants, indicated that the ants undoubtedly were willing and perhaps did perform their share of the compact, and that the aphis were unable to subsist upon the tissue of these host plants. Aphis in the winged stage, probably, lodged many times upon the immune plants.

It was learned that there were two recognizd forms of aphis involved in the problem, namely, the corn root-aphis, *Aphis maidiradicis*, and the corn plant-aphis, *Aphis maidis;* one working only or almost entirely on the roots and the other on the culm of the corn plant. The former is more numerous and destructive in corn fields.

The attacks of the sap-sucking aphids do not produce disease other than depleted plant tissue and local lesion in the area upon which they are at work. A portion of the insect secretions is waste—popularly known as "honeydew"—and produces the characteristic sticky, gummed and soiled surface where the aphis and the ants have been operating.

Just as there is no important grape-growing region free from the devastating woolly aphis or phylloxera of the vine; so, also, there is probably no corn-growing region of importance, in North America at least, which is free from the root-aphis of corn. There is no way of estimating accurately the enormous loss in reduction of yield caused by these insects which are steadily increasing in numbers and extent of migration, but this loss is known to be very great indeed. In Central Illinois the damage by the corn root-aphis sometimes causes total failure of the crop in limited areas.

Careful cultural methods may reduce considerably, for the time being, the number of aphis in a cornfield; yet the field may become reinfested from surrounding, untreated fields of corn and from other plants upon which the aphis are known to subsist.

Forbes reports finding from eleven to twenty-two generations of corn root-lice in one season. He estimates three hundred and nineteen billion lice and three trillion eggs left in the ground at the end of the season for each louse hatched in the spring. These figures are based upon the average rate of production with no undue break in the cycle.

It is this high rate of multiplication by a number of successive generations which makes the root lice so destructive, even in fields first entered by a few winged lice borne on the wind from some neighboring field which has become more or less overstocked.

We may conclude that improved cultural methods and other common treatment will, at best, protect the cornfield only for a short interval. A more effectual remedy and permanent solution of the problem is to be welcomed. The amount of work connected with a thorough investigation of this discovery would have been far greater than the writer was able to undertake personally in connection with his other duties.

Perhaps in no one instance of reported resistance to disease and insect attack has the nature of the immunity been fully ascertained or circumscribed, although it is generally conceded as being highly desirable to determine the particular immunizing properties. In some cases it is thought to be due to hardiness of the individual, or vigor of growth; in others, to the durability, composition, or peculiarity of structure of the affected tissue.

In the plantlet stage of growth there is not much difference between the corn and the teosinte except that the leaves and stem of the latter are narrower and more slender. As the plants grow older the leaves of the teosinte are tougher and more leathery in texture, with pronounced teeth along the edges of the leaf. The corn leaves become slashed and torn to ribbons by wind storms, while the long narrow, and tough leaves of the teosinte remain entire. The sap of the corn plant is sweeter than the sap of the teosinte.

In the above-mentioned features the F_1 resembles the teosinte more than it does the corn. Since the aphis are sap suckers, the sweeter juice and more readily penetrated epidermis of the corn plant may be the deciding factors of immunity for the teosinte and the hybrid. This remarkable immunity apparently provided material upon insect parasitism as a means of determining genetic relationship and elucidation of the problem of inheritance of immunizing properties in plants.

W. B. Gernert
Illinois Agricultural Experiment Station,
Urbana, Ill.

SPECIAL ARTICLES

THE TILLERING OF WHEAT

During the past eight years the writer has made a rather extended study of the tillering of winter wheat. The factors studied may be divided into two general classes, viz., heredity and environment. It has been found that the tendency to tiller appears to be largely a varietal characteristic. In order to study the behavior of the wheat plant with respect to tillering it was found necessary to plant the kernels in hills 6 by 6 in. apart. Two kernels were planted and later the plants thinned to one per hill. This method of seeding allowed the plant sufficient space to express rather fully its tendency to tiller. Seedings were also made by drilling in rows as is usually done in practical wheat culture. In this case, however, the number of tillers per plant could not be so accurately determined at harvest owing to the crowded condition of the plants in the row. As the plants came up the number was determined for a definite length of drill row. At harvest the total number of culms within this space was noted and divided by the number of plants. This gave the average number of tillers per plant. Where the wheat was seeded in hills each plant was cut separately and the culms counted. The mean for each variety was then determined by dividing the total number of culms by the number of plants. More than 150 varieties and strains of winter wheat were included in these tests. It was noted that the bearded wheats as a class seem to tiller more freely than the smooth. In order to test this characteristic of varieties more thoroughly identical varieties were grown the same season on both fertilized and untreated soil. All of the experiments were conducted in the field. The following table gives the average number of tillers per plant for four varieties of wheat, two smooth and two bearded.

TABLE I

Number of Tillers per Plant of Four Varieties Grown under Different Conditions

Test No.	Smooth		Bearded	
	Red Wave	Invincible	Red Wonder	Mediterranean
1	5.13	4.74	6.19	7.95
2	5.05	4.13	6.73	6.72
3	5.45	6.24	8.81	8.90
4	3.39	4.04	5.58	6.68
5	7.10	6.28	8.58	9.39
6	2.94	2.78	4.02	4.44
7	4.08	4.81	6.33	7.16
8	2.20	2.73	3.15	4.63
9	1.09	1.22	1.77	1.92
10	1.02	.98	1.29	1.45
11	.98	.97	1.06	1.20
12	1.14	2.04	2.95	2.63
13	1.01	1.07	1.81	1.69
14	1.01	1.19	1.46	1.39

As indicated in the table these varieties were grown under 14 different conditions, covering a period of eight years. In tests one to eight inclusive the varieties were grown individually by the hill method, while in the remainder of the tests the grain was grown in drill row. It will be noted from Table I. that the bearded varieties have produced more tillers per plant in every case.

In Table II. is given the summary of the results with all varieties included in the different tests on tillering. The number of varieties together with their repetition in the 13 different tests amounts to 973 cases. For the sake of convenience the ten highest and the ten lowest tillering varieties in each test are separated into a smooth and a bearded group.

TABLE II

Summary of Variety Test on Tillering showing the Proportion of Bearded and Smooth Varieties in the Highest and the Ten in Each Test

Test No.	No. of Varieties			Highest Ten		Lowest Ten		No. of Tillers per Plant	
	Total	Bearded	Smooth	Bearded	Smooth	Bearded	Smooth	Bearded	Smooth
1	84	51	33	10	0	1	9	1.37	1.12
2	76	37	39	9	1	2	8	2.15	1.95
3	57	25	32	8	2	0	10	1.26	1.11
3–*a*	57	25	32	7	3	1	9	1.08	1.01
4	67	31	36	9	1	2	8	7.70	6.02
5	58	29	29	9	1	3	7	3.21	2.85
5–*a*	58	29	29	8	2	3	7	1.68	1.46
5–*b*	58	29	29	9	1	4	6	1.10	1.06
6	113	60	53	10	0	2	8	1.40	1.23
6–*a*	113	60	53	9	1	2	8	1.18	1.04
7	53	25	28	7	3	1	9	1.28	1.13
8	80	42	38	7	3	1	9	2.95	2.50
8–*a*	80	42	38	9	1	2	8	1.63	1.35
Total				111	19	24	106		
Per Cent.				85	15	20	80		

The number of tillers per plant refers to the average for all bearded and all smooth included in each test. It will be seen that the larger proportion of the high tillering varieties in every test is bearded while the greater number of the low tillering varieties is smooth. Of the 130 cases of the ten highest tillering varieties, 111, or 85 per cent., are bearded; of the 130 cases of the ten lowest tillering varieties, 106, or 80 per cent., are smooth. The results of these tests indicate that the bearded varieties have a greater capacity for tillering than the smooth.

In the study of environmental factors it was found that the rate of seeding a space per plant has a marked influence on the number of tillers produced per plant. Close seeding resulted in a smaller number of tillers per plant, earlier maturity and a better quality of kernel than wide seeding. The time of seeding determines to a large extent the rate of tillering. Early seeding is accompanied by a larger number of tillers per plant than late seeding. The time of seeding, the number of tillers per plant, the yield per plant and the quality of grain are closely correlated. The competition between plants induced by heavy seeding is more marked among smooth wheats than among the bearded. It appears that heavy seeding has a greater effect in lessening the number of tillers, the length of culm, spike, and yield of grain in smooth wheats than in bearded. The fertility of the soil is a factor that directly affects the rate of tillering. Nitrogen and phosphoric acid seem to stimulate the production of tillers; potash has little or no effect. The relation of tillering to yield is shown by the increase in the yield per spike as the number of tillers per plant increases to 4 or 5, beyond this the yield per spike is more or less uniform. The low tillering plants of a variety produce a smaller yield per spike, and the grain is of poorer quality. These experiments have shown quantitatively the effects on the rate of tillering of such factors as time and rate of seeding, the kinds of fertilizer and the relation of the number of tillers per plant to other characters. The tendency of bearded wheats to tiller more freely than the smooth has not been brought before to the attention of the wheat grower. A close analysis of these results indicates that there is a physiological difference between the two types of wheat which may mean that the bearded sorts are able to make better use of the plant food supplied or are able to extract it from

the soil more easily than the smooth type of grain.

A. E. Grantham
Delaware Agricultural Exp. Station

A MEANS OF TRANSMITTING THE FOWL NEMATODE, HETERAKIS PAPILLOSA BLOCH[1]

A recent experiment demonstrated that the fowl nematode, *Heterakis papillosa* Bloch[2] may be transmitted to chickens by the feeding of a dung earthworm, *Helodrilus gieseleri hempeli* Smith.[3] The thirteen fowls (three of them controls) used in the experiment were hatched in an incubator, reared in a worm-proof field cage,[4] and given food free from animal tissues, while the dung earthworms were taken from a poultry yard in which the fowls were heavily infected with *H. papillosa*. When these chicks were about five weeks old, they were given dung earthworms every few days until each chick had ingested approximately forty worms. Of ten chicks so fed, four became infected with *H. papillosa*, the results of these examinations being as follows:

Chick 104, examined sixty-four days after first feeding, nine nematodes in the cæca.

Chick 117, examined one hundred thirty-seven days after first feeding, one nematode in the right cæcum.

Chick 128A, examined twenty-nine days after feeding, two nematodes in the cæca.

Chick 130A, examined twenty-seven days after feeding, two nematodes in the cæca. The six remaining chicks and the three controls were free from nematodes.

As is well known, these small nematodes commonly occur in the cæca of fowls, although they are not infrequently found in the large intestine. Of three hundred ninety-five chickens taken locally and examined in this laboratory during the last three years, two hundred ninety-three (74.1 per cent.) were infected with *H. papillosa*. The average infection was 34.4 nematodes, but a single infection of one hundred nematodes is not uncommon, and in one instance a fowl contained three hundred twenty-six of these parasites.

The means by which chickens become infected with *H. papillosa* is not wholly understood. Evidently, in some cases, a dung earthworm transmits these nematodes, but whether the relation between the two worms is one of parasitism or merely that of an association has not been fully determined. The presence of certain nematodes both free in the nephridia and imbedded in the muscles of earthworms furnishes a suggestive hypothesis. Dung earthworms are of common occurrence in the local poultry yards, and it might be possible to account for the rather heavy nematode infection of fowls from this source alone. But Leuckart long ago pointed out that *H. papillosa* may develop directly, according to Railliet and Lucet,[5] who, by feeding to a fowl eggs removed from the uterus of *H. papillosa*, secured a direct infection of fifteen of these nematodes. The writer, likewise, has obtained direct infections by giving eggs of this nematode to fowls reared under controlled conditions. These data indicate that the relation of the nematode to the earthworm is that of an association, in which case the eggs of the former might be carried on the slimy surface of the earthworm or in its engulfed food. However, the evidence is not such as to preclude the possibility that this earthworm, *H. gieseleri hempeli*, may, in some way, serve as an intermediate host of *H. papillosa*, and it is hoped that experiments now under way will reveal the nature of this relation.

James E. Ackert
Manhattan, Kans.

[1] Contribution No. 19 from the Zoological Laboratory, Kansas State Agricultural College. Aid of Adams Fund.

[2] The identification of this nematode has been verified by Dr. B. H. Ransom, Zoologist, B. A. I., U. S. Dept. Agr., Washington, D. C.

[3] The earthworms were identified by Professor Frank Smith, University of Illinois.

[4] The field cage with its floor and eighteen-inch walls of cement is so constructed as to be practically insect-proof also. Examinations of control chickens every few weeks for three years have not yielded a single parasitic worm.

[5] Railliet, A., et Lucet, A., "Observations et expériences sur quelques helminths du genre *Heterakis* Dujardin," *Bull. Soc. Zool. France*, Par., 17: 117–120, 1892.